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Winther, Grethe

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Dislocation content and alignment of boundaries in a fcc crystal deformed in plane strain

Grethe Winther

Department of Mechanical Engineering, Technical University of Denmark, DK-2800 Kgs. Lyngby, Denmark

The deformation-induced extended planar dislocation boundaries in fcc crystals deformed to medium strains ($\varepsilon<1$) align with preferred crystallographic planes, which depend on the grain orientation [1]. Based on extensive studies of tensile deformed and rolled samples this grain orientation dependence has been traced to a dependence on the active slip systems [2], further implying that the dislocations in the boundaries glide on these systems.

The boundary dislocations have recently been characterised by transmission electron microscopy for a single selected boundary in rolled copper [3] and a number of similarly aligned boundaries in rolled aluminium [4]. The results confirm that the boundary dislocations come from the active slip systems and show that they are organised in a network fulfilling the Frank equation [5], for a boundary free of long-range stresses.

Recent investigations [6] of a nickel single crystal strained in the (110) plane by wedge indentation giving rise to activation of 6 {111}<110> slip systems, organised in 3 effective pairs lying the (110) plane, has inspired the present theoretical survey of the possible dislocation configurations and crystallographic planes of boundaries fulfilling the Frank equation coming from these slip systems. The results are presented and discussed. Finally, the predictions are compared to theoretical and experimental results for an aluminium crystal of a similar orientation deformed by rolling.

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